discussions, and to A. S. Borovik-Romanov and N. M. Kreines for interest in the work and for fruitful suggestions.

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OBSERVATION OF THE PHONON "BOTTLENECK" WITH THE AID OF MADEL'SHTEM-BRILLOUIN SCATTERING

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The possibility of investigating the spin-phonon interaction in paramagnets with the aid of Mandel'shtam-Brillouin scattering (MBS) was indicated in [1, 2]. So far, only one experiment was performed in this direction.

By using the usual MBS technique, we observed directly the phonon "bottleneck" effect in cerium-magnesium double nitrate (CeMN) under the following conditions. The investigated sample, measuring 4.5 x 4.5 x 9 mm, was placed in a rectangular resonator cooled to 1.5°K, in which a type H_{10} mode was excited at a frequency 14.2 GHz. A constant magnetic field was applied perpendicular to the trigonal axis of the crystal C_3, since $g_{\parallel} = 0$ and $g_{\perp} = 1.83$ for the Ce^{3+} ions in the double nitrate. In view of the absence of a hyperfine structure, a single EPR line was observed in a field H_0 = 5550 Oe, corresponding to spin transitions between the levels of the lower doublet of the Ce^{3+} ions. The exciting light was emitted by a helium-neon laser of 25 mW power, operating at a wavelength of 6328 Å. The scattered light was observed at 90° to the incident beam and was directed along the C_3 axis. Under these conditions, the MBS spectrum is produced only by the Debye elastic waves propagating at an angle of 45° to the C_3 axis. To observe the phonon "bottleneck" we chose longitudinal elastic waves, for in accordance with our measurements they yield more intense spectral MBS line in the investigated crystal. At the indicated optical orientation of the sample, the frequency of these oscillations was 14.2 GHz at helium temperatures.

The stationary saturation of the EPR line of the cerium ions led to a sharp increase of the intensity of the observed MBS component; this increase is obviously due to the "heating" of the phonons in the frequency band determined by the width of the EPR line, due to the spin relaxation in the presence of the phonon "bottleneck". Comparative measurements of the intensity of these components under saturation conditions and in the absence of the latter, yielded for the temperature of the "hot" phonons a value of 100°K. Thus, the temperature of the resonant phonons was increased by almost 70 times over their equilibrium temperature 1.5°K.

Starting from the experimental conditions, we can estimate theoretically the temperature of the "hot" phonons, to this end we write down the σ-factor of the "bottleneck" [4, 5] in the form

$$\sigma = \frac{\tau_{ph} v^3 c}{4\pi\nu^2 \Delta\nu T_1} \, th^2\left(\frac{h\nu}{2kT}\right) .$$

Here $v = 4.2 \times 10^5$ cm/sec is the velocity of the longitudinal oscillations; $c = 1.6 \times 10^{21}$ cm^{-3} is the concentration of the paramagnetic particles; $\nu = 14.2$ GHz is the frequency of the resonant phonons; $\Delta\nu = 400$ MHz is the spectral width of the band of the "hot" phonons, assumed equal to the width of the EPR line; $T = 1.5^\circ K$ is the temperature of the thermostat; $\tau_{ph} = \ell/2v = 8 \times 10^{-7}$ sec is the phonon relaxation time and is determined by the sample dimension ℓ; $T_1 < 3 \times 10^{-2}$ sec is the time of the direct spin-lattice relaxation via the longitudinal phonons in the absence of the "bottleneck"[1]. The foregoing values yield $\sigma > 160$.

The temperature of the "hot" phonons T_{ph} is connected with σ by the relation [5]

$$T_{ph} = T/2\{(1 - s) + [(1 + s)^2 + 4\sigma s]^{1/2}\} ,$$

where s is the EPR line saturation factor, equal to approximately 10 under the conditions of the experiment. From this we get $T_{ph} > 50^\circ K$, which is in full agreement with the experimentally registered value $100^\circ K$.

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THICKNESS DEPENDENCE OF THE CRITICAL TEMPERATURE OF THE SUPERCONDUCTING TRANSITION OF COLD-DEPOSITED BERYLLIUM FILMS

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We have investigated the dependence of the critical temperature T_c of the superconducting transition on the thickness of beryllium films condensed at liquid-helium temperature; the superconductivity of these films was first observed by Lazarev, Semenenko, and Sudovtsev [1].

The films were prepared by thermal evaporation of small batches of metal (having a resitance ratio of about 200) from molybdenum and tungsten evaporators, unto the surface of a freshly-cleaved mica plate (in thermal contact with the glass "finger" of an ampoule immersed in liquid helium).

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1) The estimate of T_1 was obtained from the experimentally determined [5] upper limit of T_1 with allowance for the fact that in CeMN the velocities of the longitudinal and transverse waves are related like $v_t/v_\ell \approx 0.6$. We took into account here the dependence of T_1 on the magnetic field, namely $T_1 \sim H^{-5}$ [6].